REDHEADED PINE SAWFLY POST SUPPRESSION EVALUATION AND IMPACT ASSESSMENT FOR THE SEMINOLE RANGER DISTRICT, OCALA NATIONAL FOREST

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ABSTRACT

The nuclear polyhedrosis virus, Lecontvirus, was used to treat 2,755 acres of sawfly infested longleaf pine on the Ocala National Forest in Florida. The sawfly population declined drastically in the third generation, but this reduction could not be attributed to viral infection.

An impact assessment showed that 210 acres of infested longleaf pine suffered heavy tree mortality following defoliation by the sawfly. The stocking level on the acres has been reduced below a manageable level, and these acres will be regenerated. Regenerating these acres at age 15 necessitates about a $62,000 loss.

INTRODUCTION

A control project for the redheaded pine sawfly, Neodiprion lecontei (Fitch), was begun on the Seminole Ranger District, Ocala National Forest in June 1983. A nuclear polyhedrosis virus (Lecontvirus) was used to reduce the sawfly population and protect trees from further defoliation. This paper reports the pertinent results of the control effort and the impact of the sawfly on the Forest's longleaf pine resource.

METHODS

Virus Treatment

Young longleaf pine plantations were treated with the nuclear polyhedrosis virus, Lecontvirus, in June 1983 to reduce the redheaded pine sawfly population. Over a 10-day period (June 1-10), 2,755 acres were spot-inoculated from the ground (Figure 1). Infested trees along a 2 x 2 chain grid were treated with the virus using hydraulic, pump-up, backpack sprayers. Most larvae were in the third, fourth, and fifth instars at treatment time.

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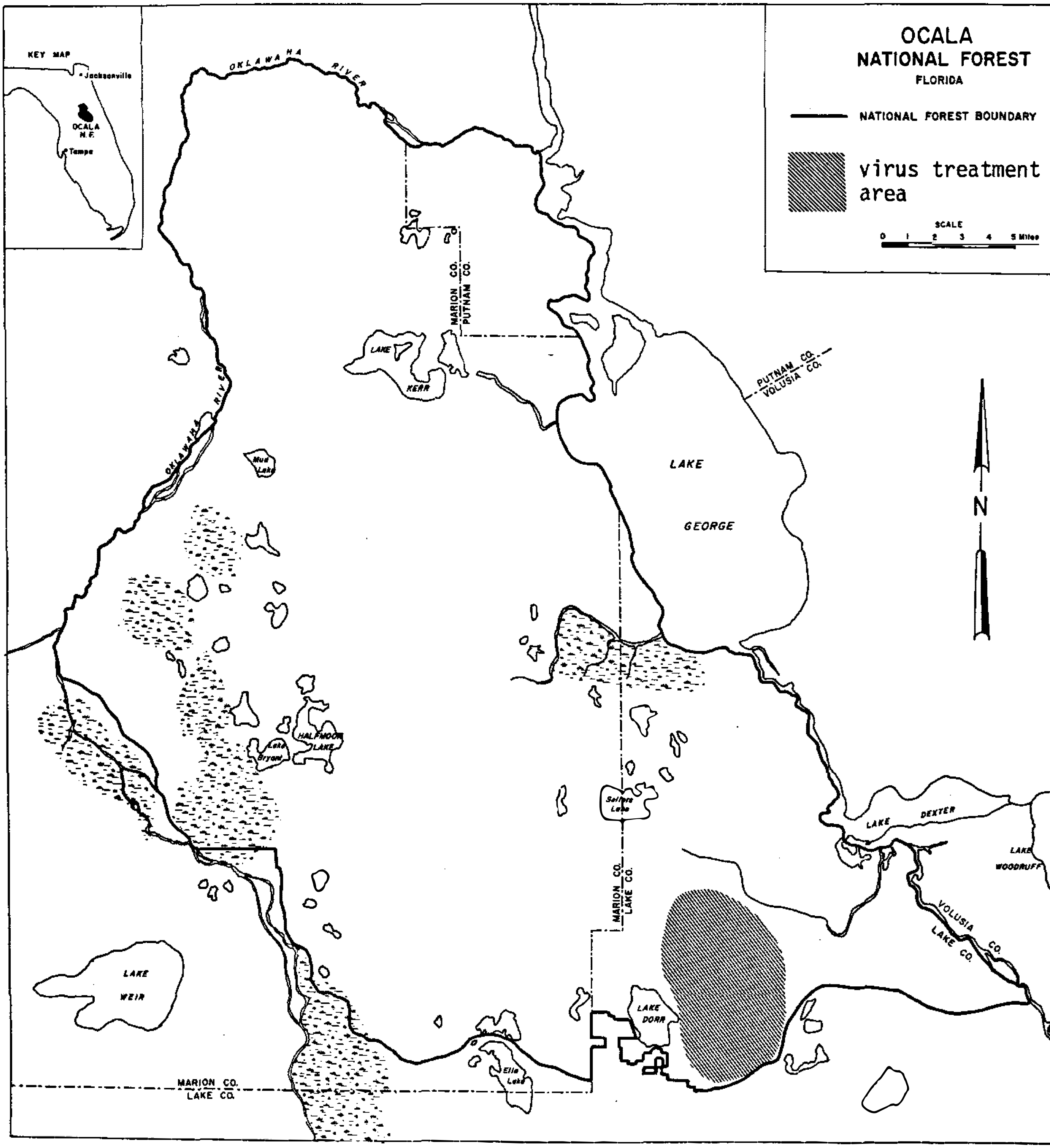
Figure 1. The general area of the 1983 redheaded pine sawfly infestation and virus treatment on the Seminole Ranger District.



Evaluating Treatment Effectiveness

Sawfly larvae were collected and examined for virus infection prior to the spray project to determine if the virus was present in the natural population. The virus was not detected. Plots were then established during the spray project to monitor the level of virus infection and virus spread from inoculated to uninoculated trees. Ten plots were set up in each of five treatment areas, and ten plots were established in each of two check areas. Each plot consisted of five trees spaced approximately fifteen feet apart. The first tree was inoculated with virus, and the other four were not inoculated. Larvae in all plots were checked for virus infection two weeks after treatment. Larvae were again checked for virus infection in August (second generation larvae) and October (third generation larvae) to determine if the virus was spreading. The level of defoliation (0, 25%, 50%, 75%, or 100%) on all trees in the plots was evaluated each time the larvae were checked for virus infection.

Impact Assessment

In January 1984, an impact survey was conducted to determine the extent of tree mortality following defoliation by the sawfly. Tree mortality occurred in clumps and rarely involved an entire stand. Color IR aerial photographs taken in October 1983 were used to delineate areas within stands with different levels of mortality. The aerial photos were interpreted using three mortality categories--severe (60-100%), moderate (40-60%), and low (0-10%). No areas were found with 10-40% mortality. Ground checks were made to verify photo interpretation. Ground checking consisted of collecting percent mortality and stocking level data on 32, 1/20-acre plots in areas having different mortality levels. Twelve plots were taken in areas with severe mortality, 18 plots in areas with moderate mortality, and 2 plots in areas with low mortality. Acreage in each mortality class was determined via the aerial photos.

An economic analysis was made to determine the loss necessitated by regenerating areas where stocking was reduced below manageable levels due to sawfly-induced mortality. Economic impact of the sawfly was determined by comparing the net present value of the areas requiring regeneration at age 15 to the net present value of the same areas assuming no mortality and growth to rotation age with negligible growth loss. In the first scenario (the actual situation), the majority of the trees are dead and have no salvage value. The areas will be regenerated. The second scenario represents the management of these areas had they not been damaged. The trees would be managed on an 80-year rotation and harvested by the shelterwood method, which entails a seed cut at age 65, followed by the final harvest at age 75. Areas with stocking levels above 300 stems per acre would be thinned at ages 35 and 45. Areas with less than 300 stems per acre would not be thinned. Less than 300 stems per acre is a low stocking level and generally considered unmanageable. There are certain cases, however, where this stocking level is acceptable. For instance, if a particular site was difficult to regenerate which resulted in low stocking, it may be carried to rotation age without thinning.

Of the 210 acres to be regenerated, 38 acres had low stocking prior to the sawfly infestation, and 172 acres were fully stocked. Therefore, two comparisons are made. One between areas regenerated and areas allowed to grow to rotation with two thinnings (fully stocked areas), and the other between areas

regenerated and areas allowed to grow to rotation age with no thinning (low stocked areas). The net present value of each scenario was determined by calculating the value of the discounted costs and revenues at a 4 percent discount rate. The value lost necessitated by regenerating at age 15 was determined by subtracting the net present value of the regeneration scenario from the net present value of the scenario where trees continue to grow to rotation age.

The yield, cost, and revenue figures were obtained from the silviculturist on the Seminole Ranger District. The yield figures and associated costs and revenues were determined from sales data for National Forests in Florida, and are the most accurate available for the Seminole District. The costs and revenues were increased by a real, noninflationary rate to reflect price increases with the passage of time. A real rate of 1 percent was used for costs and revenues associated with thinning. A real rate of 2 percent was used for the seed cut and final harvest costs and revenues. Inflation has not been considered in this analysis for either costs or revenues.

RESULTS

Effectiveness of Virus Treatment

Assays of Lecontvirus by Dr. R. C. Wilkinson, prior to treatment, showed that the virus was active. Pre-treatment examination of larvae showed that they were not infected with the nuclear polyhedrosis virus. Two weeks after treatment, at the end of the first generation, small numbers of virus-killed larvae were found, but only on treated trees. This indicated that the virus had infected some larvae, but not nearly the number anticipated. Lecontvirus is very virulent, and large numbers of dead larvae were expected on the inoculated trees. Examination of second generation larvae revealed very little evidence of virus infection, and there was no evidence that the virus had spread.

The first and second generation sawfly populations were very large, and considerable defoliation occurred in heavily infested stands. There was no significant difference in defoliation levels between the treatment and check areas or between the first and second generations--another indication that the virus treatment was ineffective in reducing the sawfly population.

By the third generation, the population declined drastically, but no evidence could link this sudden decline to the virus. Sawfly populations declined in the check areas, as well as the virus-treated areas. No virus-infected larvae could be found. Defoliation was much lighter during the third generation due to population decline.

Impact Assessment

The results of the impact assessment show that the stocking level on 210 acres has been reduced below a manageable level due to tree mortality which occurred following repeated, heavy defoliation by the redheaded pine sawfly. All of these areas were heavily defoliated by the sawfly in 1982 and again in 1983. These acres will be regenerated. Table 1 shows the stands which contain areas of mortality, acres involved, percent mortality, and stocking levels before and after sawfly defoliation.

Table 1.--Stands containing tree mortality due to sawfly defoliation, acreage involved, percent mortality, and stocking.

Location		Acres of	# Check		Stocking Level (stems/acre)	
Compartment	Stand	Mortality	Plots Taken	% Mortality	Before Trees Died	After Trees Died
262	25	2	1	76	580	139
262	31	2	1	90	680	82
266	14	7	3	64	373	134
289	3	23	1	95	400	20
289	14	86	2	98	430	9
290	8	52	4	46	370	200
266	16	2	4	75	200	50
289	15	15	7	56	191	84
289	33	21	7	50	150	75

The economic analysis indicates that the present value of the loss incurred by regenerating 210 acres of longleaf pine at age 15 was $62,000. Because the contrasted scenarios have unequal time lengths, a more precise comparison is the equivalent annual revenue of the two scenarios. The equivalent annual revenue is defined as "the annual revenue needed at a given discount rate (4 percent in this analysis) to equal the net present value of the stand." Hence, the revenue per acre can be compared in a similar time span (one year) between the two scenarios. The difference in the two scenarios is the equivalent annual loss that would be sustained if the original acres had to be regenerated at age 15 (Tables 2, 3, and 4). The total loss incurred in the 210 acres of infested longleaf pine was approximately $62,000 (the addition of the net present value of loss due to sawfly in Tables 3 and 4), while the equivalent annual loss incurred in the 210 acres of infested longleaf was approximately $2,800 (the addition of equivalent annual loss due to sawfly in Tables 3 and 4). The results of both measures (net present value and equivalent annual revenue) indicate that substantial losses will occur when an existing 15 year old stand must be destroyed and regenerated.

DISCUSSION

Although the sawfly population declined drastically in the third generation, the evidence does not indicate that it was caused by Lecontvirus. Two weeks after the virus treatment, dead larvae were found which contained what appeared to be the polyhedra characteristic of this virus. However, collections of larvae from the second generation revealed no virus infection. In fact, it was difficult to find dead larvae. The larval population remained high throughout the first and second generations. But the third generation larval population, which is usually the largest, remained very small. Only one colony of virus-infected larvae cound be found. Dr. Drion Boucias at the University of Florida determined that these larvae were infected with a virus, but not Lecontvirus.

The population decline in the third generation cannot be attributed to virus infection, because virus-infected larvae could not be found. Further, larval populations declined in both the untreated and treated areas. This indicates that some other factor was affecting the entire population.

There are several possible reasons why the virus treatment was not as effective as expected:

1. The virus may have been applied too late in the larval life stage. The virus was applied to third, fourth, and fifth instars. Canadian researchers, who developed the use of this virus, recommend that it be applied to first and second instars. However, Dr. Wilkinson, University of Florida, found the virus to be very effective in killing later instars.

2. The virus may have been inactivated by the extremely high temperatures at application. The air temperature ranged from 85-100°F at the time the virus was being applied. Although the tank mixtures were checked periodically and cooled with ice as needed, the virus was exposed to very hot temperatures and bright sunlight as soon as it hit the foliage. It is possible that the virus was inactivated before the larvae had a chance to consume it. A UV protectant was not recommended, but in retrospect may have been necessary in this situation.

Table 2.--Stand suffers heavy mortality, stocking is reduced below a manageable level, and the stand is regenerated at age 15.

Year	Management Schedule	Yield (MCF/acre)	Cost (per acre)	Revenue (per acre)
0	Most of the trees have died and fallen over			
	No salvage value			
	Double chop or use a herbicide for site preparation		70.00	
	Plant 1,100 seedlings/acre		46.00	
1	Survival check		1.00	
	Brown spot check		.50	
3	Certification check		.50	
	Brown spot check		.50	
34	Sale preparation		35.75	
35	Thinning	.25		69.25
44	Sale preparation		57.20	
45	Thinning	.40		110.80
64	Sale preparation		72.24	
65	Seed cut	.84		459.48
74	Sale preparation		45.43	
75	Final harvest	.59		332.17

Net present value @ 4% - $98/acre
Equivalent annual revenue @ 4% - $4/acre

Table 3.--Stand does not suffer heavy mortality due to sawfly defoliation and grows to rotation age. Management strategy - shelterwood with 2 thinnings. This strategy is used when stocking exceeds 300 stems per acre, as in the first six stands in Table 1.

Year	Management Schedule	Yield (MCF/acre)	Cost (per acre)	Revenue (per acre)
0	Stand is age 15			
19	Sale preparation		35.75	
20	Thinning (year 35 of management plan)	.25		69.25
29	Sale preparation		57.20	
30	Thinning (year 45 of management plan)	.40		110.80
49	Sale preparation		72.24	
50	Seed cut (year 65 of management plan)	.84		459.48
59	Sale preparation		45.43	
60	Final harvest (year 75 of management plan)	.59		332.17

Net present value @ 4% - $429/acre
Equivalent annual revenue @ 4% - $19/acre

	Net Present Value	Equivalent Annual Revenue
Stand unaffected by sawfly and grows to rotation age - 2 thinnings.	$429/acre	$19/acre
Stand which must be regenerated at age 15	- 98/acre	4/acre
Value lost due to the redheaded pine sawfly infestation.	$331/acre	$15/acre
Acres affected with greater than 300 stems/acre	x 172	x 172
Net present value of loss due to sawfly	$56,932	
Equivalent annual loss due to sawfly		$2,580

Table 4.--Stand does not suffer heavy mortality due to sawfly defoliation and grows to rotation age. Management strategy - shelterwood with no thinning. This strategy is used when stocking is less than 300 stems per acre, as in the last three stands in Table 1.

Year	Management Schedule	Yield (MCF/acre)	Cost (per acre)	Revenue (per acre)
0	Stand is age 15			
49	Sale preparation		75.80	
50	Seed cut (year 65 of management plan)	.75		396.32
59	Sale preparation		54.55	
60	Final harvest (year 75 of management plan)	.61		331.47

Net present value @ 4% - $226/acre
Equivalent annual revenue @ 4% - $10/acre

	Net Present Value	Equivalent Annual Revenue
Stand unaffected by sawfly and grows to rotation age - no thinning.	$226/acre	$10/acre
Stand which must be regenerated at age 15.	- 98/acre	4/acre
Value lost due to the redheaded pine sawfly infestation.	$128/acre	$ 6/acre
Acres affected with less than 300 stems/acre	x 38	x 38
Net present value of loss due to sawfly	$4,864	
Equivalent annual loss due to sawfly		$228/acre

3. Spot ground inoculation of almost 3,000 acres proved to be impractical and possibly ineffective. Spraying took place over 10 days when the larvae were already in the mid to late instars. We may have had better success had we treated the entire area in a shorter period of time. This could be accomplished through aerial application of the virus. Nonetheless, spot inoculation may be very practical in recreation areas and on small acreages.

RECOMMENDATIONS

To increase future effectiveness of Lecontvirus treatment in Florida, we first need to determine if the virus can remain active at high temperatures typical of this area. If the virus does remain effective at high temperatures, the treatment method could be improved by applying the virus to earlier instars (1st and 2nd) by aircraft. If early instars cannot be treated, it would be more effective to wait and treat early instars in the next generation. It would also be advisable to try a UV protectant.

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